Claims

[c1] 1.An apparatus for growing stoichiometric lithium niobate and lithium tantalate single crystals, the apparatus comprising:
a chamber,
a crystal pulling system,
a long crucible arranged inside the chamber;
a separation member arranged in the long crucible to divide an inner space of the long crucible into a melting zone and a feeding zone, wherein the melting zone is located above the feeding zone;
a heating system surrounding a sidewall of the chamber; and
a pushing/rotating system arranged under the long crucible to rotate and push the long crucible.

[c2] 2.The apparatus of claim 1, wherein the separation member comprises an insulative plate, a shallow crucible, and a crucible with a perforated wall.

[c3] 3.The apparatus of claim 1, wherein the separation member is made of a material selected from platinum.

[c4] 4.The apparatus of claim 1, wherein the separation member is made of a material selected from iridium.

[c5] 5.The apparatus of claim 1, further comprising a preheater outside the chamber, corresponding to the position of the feeding zone.

[c6] 6.The apparatus of claim 1, further comprising a post-heater outside the chamber, corresponding to the upper portion of the long crucible.

[c7] 7.A method for growing stoichiometric lithium niobate and lithium tantalate single crystals by using the apparatus of claim 1, the method comprising:
charging a solid feed material in a feeding zone of the long crucible, wherein the feeding zone in a lower portion of the long crucible;
placing the separation member above the feeding zone of the long crucible;
charging a zone stuff in a melting zone of the long crucible, wherein the melting zone of the long crucible is located in an upper portion of the long crucible;

melting the zone stuff while keeping the feed material in the feeding zone as solid;

placing a crystal seed into the melting zone of the long crucible;

pull-growing a crystal body after the crystal body is melted; and

pushing the long crucible upward as the crystal body is grown.

[c8] 8.The method of claim 7, wherein the solid feed material contains stoichiometric lithium niobate.

[c9] 9.The method of claim 7, wherein the zone stuff contains 58-60% of $Li_2O/(Li_2O+Nb_2O_5)$.

[c10] 10.The method of claim 7, wherein the solid feed material contains stoichiometric lithium tantalate.

[c11] 11.The method of claim 7, wherein the zone stuff contains 58-60% of $Li_2O/(Li_2O+Ta_2O_5)$.

[c12] 12.The method of claim 7, further comprising doping the solid feed material in the feeding zone with a dopant which has a first concentration.

[c13] 13.The method of claim 12, further comprising doping the zone stuff in the melting zone with a dopant which has a second concentration, wherein the ratio of the first concentration with respect to the second concentration is K, a segregation constant for the dopant.

[c14] 14.The method of claim 12, wherein the dopant is selected from magnesium oxide, zinc oxide, manganese, cerium, terbium, and iron.

[c15] 15.The method of claim 7, wherein the pulling rate of the crystal body is proportional to the pushing rate of the long crucible.

[c16] 16.The method of claim 7, wherein the ratio of the pulling rate of the crystal body with respect to the pushing rate of the long crucible is approximately equal to the ratio of the inner cross sectional area of the long crucible with respect to the cross sectional area of the crystal body, depending on the sintering density of the feeding material.

[c17] 17.The method of claim 7, further comprising:
slowly cooling down the chamber to room temperature after the crystal body is grown a predetermined length, and
removing the crystal body.

[c18] 18.An apparatus for growing stoichiometric lithium niobate and lithium tantalate single crystals, the apparatus comprising:
a chamber,
a crystal pulling system arranged above the chamber,
a long crucible arranged inside the chamber;
a heating system surrounding sidewall of the chamber; and
a pushing/rotating system arranged under the long crucible to rotate and push up the long crucible.

[c19] 19.The apparatus of claim 18, wherein the heating system further comprises a preheater outside the chamber, corresponding to the position of the feeding zone.

[c20] 20.The apparatus of claim 18, wherein the heating system further comprises a post-heater outside the chamber corresponding to the upper portion of the long crucible.

[c21] 21.A method for growing stoichiometric lithium niobate and lithium tantalate single crystals by using the apparatus of claim 18, the method comprising:
charging a solid feed material in the long crucible;
charging a zone stuff above the solid feed material in the long crucible;
melting the zone stuff while keeping the underlying solid feed material in a solid phase;
placing a crystal seed in the zone stuff of the long crucible;
pull-growing a crystal body after the crystal body is melted; and
pushing the long crucible upward as the crystal body is grown.

[c22] 22.The method of claim 21, wherein the solid feed material contains stoichiometric lithium niobate.

[c23] 23.The method of claim 21, wherein the zone stuff contains 58-60% of Li_2O/

$(Li_2O+Nb_2O_5)$.

[c24] 24.The method of claim 21, wherein the solid feed material contains stoichiometric lithium tantalate.

[c25] 25.The method of claim 21, wherein the zone stuff contains 58-60% of $Li_2O/(Li_2O+Ta_2O_5)$.

[c26] 26.The method of claim 21, further comprising doping the solid feed material in the feeding zone with a dopant which has a first concentration.

[c27] 27.The method of claim 26, further comprising doping the zone stuff in the melting zone with a dopant which has a second concentration, wherein the ratio of the first concentration with respect to the second concentration is K, a segregation constant for the dopant.

[c28] 28.The method of claim 26, wherein the dopant is selected from magnesium oxide, zinc oxide, manganese, cerium, terbium, and iron.

[c29] 29.The method of claim 21, wherein the pulling rate of the crystal body is proportional to the pushing rate of the long crucible.

[c30] 30.The method of claim 21, wherein the ratio of the pulling rate of the crystal body with respect to the pushing rate of the long crucible is approximately equal to the ratio of the inner cross sectional area of the long crucible with respect to the cross sectional area of the crystal body, depending on the sintering density of the feeding material.

[c31] 31.The method of claim 21, further comprising:
slowly cooling the chamber to room temperature after the crystal body is grown a predetermined length, and
removing the crystal body.